इंटरनेट मानक

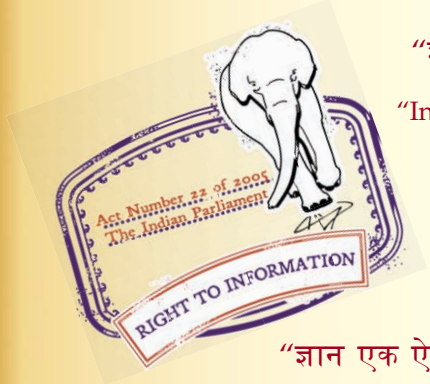
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 8198 (2004): Steel Cylinders for Compressed Gases (Atmospheric Gases, Hydrogen, High Pressure Liquefiable Gases and Dissolved Acetylene Gases) - Code of Practice [Amalgamation of IS 847(Part 1 to 4)] [MED 16: Gas Cylinders]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

IS 8198 : 2004
[Superseding IS 8198 (Parts 1 to 4) : 1984]

भारतीय मानक

संपीडित गैस के लिए इस्पात के सिलिंडर (वायुमंडली गैस, हाइड्रोजन, उच्च दाब द्रतहिय गैस और घुलनशील एसीटलीन गैस) — रीति संहिता

Indian Standard

STEEL CYLINDERS FOR COMPRESSED GASES (ATMOSPHERIC GASES, HYDROGEN, HIGH PRESSURE LIQUEFIABLE GASES AND DISSOLVED ACETYLENE GASES) — CODE OF PRACTICE

ICS 23 020 30

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 2004 **Price Group 7**

Gas Cylinders Sectional Committee, ME 16

FOREWORD

This Indian Standard was adopted by Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council

Steel cylinders for compressed gases like atmospheric gases, hydrogen gases, high pressure liquefiable gases and dissolved acetylene gas were earlier covered in IS 8198 (Part 1), IS 8198 (Part 2), IS 8198 (Part 3) and IS 8198 (Part 4) respectively, which were published in 1984 Since various items given in these standards were identical in nature, therefore in order to make them more user friendly, these standards have been amalgamated into a single standard Accordingly this standard supersedes IS 8198 (Part 1), IS 8198 (Part 2), IS 8198 (Part 3) and IS 8198 (Part 4) The other parts of IS 8198 shall remain in force which are given as under

Part 5	Liquefied petroleum gas (LPG)
Part 6	Liquefied chlorine gas
Part 7	Ammonia gas
Part 8	Common organic refrigerated gases
Part 9	Sulphur dioxide gas
Part 10	Methyl bromide gas
Part 11	Methyl chloride gas
Part 12	Gases for medical use

For safe handling of cylinders containing compressed gases, one should be thoroughly conversant with the properties and characteristics of these gases There are several precautions and safe practices which are to be observed on account of the nature of the gas and also because of the pressure to which the cylinders are subjected

Manufacturers, fillers, and users of the gas cylinders covered by this standard should be familiar with the precautions laid down in this standard in order to ensure safe and efficient operating conditions For general information on different gases conveyed in cylinders SP 9 1973 'Technical data sheet for gases conveyed in cylinders' may also be referred to

Manufacture, possession and use of any gas, when contained in cylinders of more than 500 ml water capacity in a compressed or liquefied state, are regulated under the *Gas Cylinder Rules*, 1981, of the Government of India This standard has been prepared in consultation and agreement with the statutory authority under those rules

The composition of the Committee responsible for the preparation of this standard is given in Annex B

Indian Standard

STEEL CYLINDERS FOR COMPRESSED GASES (ATMOSPHERIC GASES, HYDROGEN, HIGH PRESSURE LIQUEFIABLE GASES AND DISSOLVED ACETYLENE GASES) — CODE OF PRACTICE

1 SCOPE

This standard covers filling, inspection, testing, maintenance and use of portable steel cylinders for the storage and transportation of atmospheric gases, hydrogen gas, high pressure liquefiable gases and dissolved acetylene gases in cylinders exceeding 500 ml water capacity

2 REFERENCES

The standards listed below contain provisions, which through reference in this text constitute provision of this standard At the time of publication, the editions indicated were valid All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below

IS No	*Title*
3224 2002	Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders — Specification (*third revision*)
3745 1978	Specification for yoke type valve connection for small medical gas cylinders (*first revision*)
4379 1981	Identification of contents of industrial gas cylinders (*first revision*)
5844 1970	Recommendations for hydrostatic stretch testing of compressed gas cylinders
7241 1981	Glossary of terms used in gas cylinder technology (*first revision*)
8433 1984	Code of practice for visual inspection of dissolved acetylene gas ylinders (*first revision*)
8451 1984	Code of practice for visual inspection of high pressure gas cylinders (*first revision*)
8775 1978	Filling pressure and corresponding developed pressure for permanent gases contained in gas cylinders
8866 1978	Filling ratios and corresponding developed pressure for high pressure liquefiable gases contained in gas cylinder
8868 1988	Periodical inspection interval of gas cylinders in use (*first revision*)
9200 1988	Methods of disposal of unserviceable compressed gas cylinders (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, definitions given in IS 7241 shall apply

4 PROPERTIES AND PHYSICAL CONSTANTS OF ATMOSPHERIC GASES

The important properties and physical constants of atmospheric gases are described briefly in Tables 1 and 2, respectively

5 APPROVED SPECIFICATION AND GENERAL GUIDANCE FOR MANUFACTURE

5.1 The cylinders used for the storage and transportation of gases shall conform to one of the specification approved by the statutory authority A list of approved specifications for filling in this country is given in Annex A

5.2 Cylinders manufactured in accordance with approved specification shall be provided with an additional wall thickness to allow for corrosion during service It shall be borne in mind that corrosion is not related to the thickness of the container so that any additional thickness allowed for corrosion should be constant, rather than a given proportion of thickness

5.3 Further additional wall thickness shall also be considered necessary in order that the cylinder can safely withstand stresses due to horizontal acceleration and retardation in normal road transportation for liquefiable gases The cylinder shall be so designed that the maximum permissible equivalent stress shall not be exceeded when the stresses in the cylinder due to vertical accelerations are superimposed upon

Table 1 Properties of the Atmospheric Gases

(*Clause* 4)

Sl No.	Gas / Properties	Air	Oxygen	Nitrogen	Argon, Neon and Krypton	Hydrogen	High Pressure Liquefiable Gases	Dissolved Acetylene Gas
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Chemical	It is a mixture of oxygen, nitrogen, carbon dioxide water vapour and inert gases	It is an active element, although does not burn, supports combustion and combines directly or *indirectly with* all elements except the rare gases	It does not react readily with other elements It neither burns nor supports *combustion* It combines with some of more active metals, such as calcium, sodium and magnesium to form nitrides	These rare gases are extremely inert All are monoatomic and are distinguished mainly by their different relative weights and atomic structures	At atmospheric temperature and pressure exists as a colourless odourless and tasteless gas It is the lightest gas, its specific gravity compared to air being only 0 069 5 It is present *in* the atmosphere only to the extent of about 0 000 1 to 0 000 2 percent at ordinary altitude It is non-toxic and non-corrosive and is difficult to liquefy since its boiling point at atmospheric pressure is −253°C Ignition can be caused with one tenth of the heat energy required by a petrol/air mixture Possible sources of ignition include sparks from static electricity sparks from electrical equipment, naked flames friction impact, compression tearing of metal and catalytic action	Non-flammable does not support combustion For nitrous oxide supports combustion to a lesser extent than oxygen	Burns in air with an intensely hot, luminous and smoky flame The ignition temperatures of acetylene and of acetylene air and acetylene-oxygen mixtures vary according to composition, initial pressure, initial temperature and water vapour content As a typical example, an air mixture containing 30 percent by volume at atmospheric pressure can be ignited at 305°C In air at atmospheric pressure the upper flammable limit is about 80 percent acetylene by volume and lower limit is 2 5 percent acetylene
ii)	Physical	It is colourless *odourless and* tasteless mixture of gases	It is colourless, odourless and tasteless gas It is slightly soluble in water and is a poor conductor of heat and electricity	It is colourless odourless and tasteless gas It is slightly soluble in water and is a poor conductor of heat and electricity	These gases are colourless, oudourless and tasteless	Burns in air with a pale blue almost invisible flame The ignition temperatures of hydrogen-air and hydrogen-oxygen vary somewhat according to factors of composition, pressure water vapour and initial temperature At atmospheric pressure the ignition temperature of either hydrogen-air or hydrogen-oxygen mixtures does not vary greatly The flammability limits of hydrogen-air and hydrogen-oxygen mixtures depend on initial pressure-temperature and water vapour content In dry air at atmospheric pressure the lower *limit is 4 1 percent hydrogen* and the upper limit is 74 2 percent hydrogen In dry	Colourless odourless and tasteless	Compound of carbon and hydrogen It is a colourless flammable gas, slightly lighter than air Acetylene of 100 percent purity is odourless but gas of ordinary commercial purity has a distinctive garlic-like odour It dissolves in water and requires one volume of water for each volume of gas An exceptionally good solvent is acetone At 20 °C and at one atmospheric

Table 1 (*Concluded*)

Sl No.	Gas / Properties	Air	Oxygen	Nitrogen	Argon, Neon and Krypton	Hydrogen	High Pressure Liquefiable Gases	Dissolved Acetylene Gas
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
						oxygen at atmospheric pressure the lower limit is 4 7 percent hydrogen and upper limit is 93 9 percent hydrogen It diffuses rapidly through porous materials and through some metals at red heat It may leak out of a system which is gas-tight with respect to other common gases at equivalent pressure		pressure, it dissolves 24 volumes of acetylene in each volume
iii)	Uses	Compressed air for blowing, spray painting, pneumatic power drills presses, etc	Oxy-acetylene flame for cutting and welding for therapeutic purpose, for resuscitation in asphyxia and with other gases in anesthesia, in high altitude flying deep sea dividing for breathing and as a power source in space programme, in steel industry to increase the capacity of the furnace, for production of nitric acid and water gas, etc	For laboratory application, blowing, and in plastic industry for extrusion, drying blanketing hot melts, and in lamp manufacturing, etc	Argon is used for arc welding, lamp industry as a blanket for production of titanium, zirconium Neon, xenon, krypton are used in lamp industry for making gas-filled electronic tubes, in atomic industry for ionization in chamber etc	Hydrogen is fundamentally a reducing agent and is frequently applied as such in organic chemical technology	-Nil-	This gas is used particularly in a confined space Liquid, solid and compressed acetylene may be violently explosive The maximum flame temperature of acetylene in oxygen is over 3 500 °C, neglecting heat losses

Table 2 Physical Constants

(*Clause* 4)

Sl No.	Gas / Properties	Air	Oxygen	Nitrogen	Argon (Ar), Neon (Ne), Krypton (Kr) and Xenon (Xe)	Hydrogen	High Pressure Liquefiable Gases		Dissolved Acetylene Gas
							CO_2	N_2O	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Molecular mass	28 964	32 0	28 013 4	Ar 39 944 Ne 20 183 Kr 83 30 Xe 131 30	2 016	44 01	44 013	26 038
ii)	Boiling point, °C	-194 35	-182 97	-195 81	Ar - 185 8 Ne - 246 0 Kr - 153 6 Xe - 108 06	-252 7	Sublimation temp –78 5	– 89 5	– 84
iii)	Density of liquid, g/cm^3	0 873 9	1 141	0 817 9	Ar 1 392 Ne 1 204 Kr 2 46 Xe 3 063	0 07	0 812 at 15°C	0 7872 at 15°C	Not applicable
iv)	Density of gas, g/l at 0°C	1 292 8	1 428 5	1 2507	Ar 1 784 Ne 0 899 9 Kr 3 741 Xe 5 897	0 089 88	1 9768	1 978 1	1 170 9
v)	Density of gas, g/l at 15°C	1 214 7	1 356 4	1 191	–	0 083 12	1 854	1 852	1 113 2
vi)	Density of gas, g/l at 27°C	1 153 2	1 299	1 143	-	0 079 09	1 755 3	1 761	1 063 5
vii)	Volume of expansion at 0°C	1/676	1/799	1/654	Ar - 1/823 5 Ne -1/141 3 Kr -1/679 3 Xe - 1/547 4	1/779			Not applicable
viii)	Volume of expansion at 27°C	1/758	1/878	1/716	–	1/885	at 15°C 1/438	at 15°C 1/425	
ix)	Percentage of volume in air	100	20 946	78 084	Ar 0 932 3 Ne 0 001 Kr 0 000 01 Xe 0 000 01	0 000 05	0 033	Not applicable	Not applicable
x)	Critical temp, °C	-140 7	-118 4	-147 1	Ar (-)122 5 Ne (-)228 7 Kr (-) 63 6 Xe 16 3	-239 9	31 04	36 5	36 3
xi)	Critical pressure (atm)	37 2	49 7	33 554	Ar 48 0 Ne 26 86 Kr 54 3 Xe 58 0	12 8	72 05	71 7	61 6

the stress due to internal pressure. The vertical accelerations considered should be those accruing in normal road transport. The provisions to be made in these and other respects as well as manufacturing tolerances to be applied shall generally be decided between the user and the manufacturer if a pronounce departure from normal practice as proposed or if other unusual features arise, the statutory authority shall be consulted.

5.4 Hydrogen cylinder material shall have sulphur content not exceeding 0 020 percent

5.5 Tensile strength of hydrogen cylinder shall be limited to 100 kg/mm^2

6 INSPECTION

6.1 Inspection During Usage

All the cylinders shall be examined for the requirements given in 6.2.1 to 6.2.6 when received for filling

6.1.1 That the cylinders shall conform to the specifications approved by the statutory authority for use in this country (*see* Annex A).

6.1.1.1 A cylinder, either not conforming to any of the specification or when the specification is not known, shall not be accepted for filling unless approved and cleared by the statutory authority

6.1.2 That the statutory requirements regarding valves, markings, fittings and painting are complied with

6.1.3 That the external condition of the cylinder body is sound Any defect, such as dent, bulge, cut, gouge, corrosion, etc, which is liable to weaken the cylinder wall as certified by a competent person will render the cylinder unfit for further use The acceptability limit of such damaged cylinders is given in IS 8433 and IS 8451.

6.1.4 That the outlet threads of valves are in good condition That the valve spindle is sound and not broken, and the gland washers, which shall be of good quality and compatible with the gas to be handled, are not worn out.

6.1.5 That the cylinder is not due for test as indicated from the markings on the cylinder

6.1.6 That the cylinders have been permitted in writing by the statutory authority for filling with the concerned gas

6.2 Periodic Inspection and Testing

Cylinders shall be periodically inspected as follows.

6.2.1 All cylinders when received for filling shall be checked by the filler if they are due for hydrostatic retesting. Testing shall be done in accordance with IS 5844, if required.

6.2.2 The cylinders are to be tested periodically at intervals given in IS 8868

NOTE — Not applicable for compressed natural gas (CNG) and dissolved acetylene (DA) cylinders

6.2.3 The testing of cylinders shall be done in testing stations approved by Chief Controller of Explosives, Nagpur.

6.2.4 All cylinders, whether new or in service, shall be carefully examined internally and externally for any damage All protective coating and foreign matter, if any, shall be removed, where necessary, prior to such examination, so that the surface can be properly examined The damage, if any, shall be carefully ascertained, the acceptability limit of the same is given in IS 8433 and IS 8451

6.2.5 The internal examination shall be conducted by an efficient low voltage electric lamp which shall give adequate illumination to have a clear view so that the defect, if any, can be detected In case of hydrogen cylinder care shall be taken to ensure that cylinder is fully purged with an inert gas such as nitrogen, alternatively washed with water, before the test lamp is inserted for inspection.

6.2.6 Cylinders shall be weighed and if the tare weight is less than 95 percent of the original tare marked on the cylinder, the cylinder shall be condemned.

NOTES

1 In case of dissolved acetylene cylinder weight is equivalent weight of shell + Weight of solvent + Weight of valve and safety devices + Gas at saturation pressure

2 For liquefiable gases tare weight includes valves

3 For other gases the tare weight is of the cylinder only

6.2.7 Cylinders which do not bear legible, mandatory identifiable markings and is not accompanied by manufacturers' test certificate and competent authority's filling permission shall also be condemned

7 DISPOSAL OF CONDEMNED CYLINDERS

7.1 Cylinders which do not comply with the requirements of inspection and testing and which have been rejected and recommended to be destroyed, shall be disposed off in accordance with IS 9200.

7.2 Record of such cylinders shall be closed and kept for a period of one year.

8 FITTINGS

8.1 Cylinders shall be fitted with a valve conforming to either IS 3224 or to any other design specification approved by the statutory authority Valves for medical cylinders, where required, shall have the appropriate

pin index in accordance with IS 3745.

8.2 It shall have a suitable neck ring and cap or valve guard for protection of the valve during transit. The valve shall be protected against damage by the provision of a stout metal cap of thickness not less than 2 5 mm Cylinders for non-toxic gases of nominal water capacity up to five litres shall be exempted from this provision Cylinders for non-toxic gases of nominal water capacity above 5 l and up to 10.5 l may not be provided with valve protection cap, if approved by the statutory authority. The cap shall be so made that it is nowhere in actual contact with any part of the valve or valve body. Every valve cap shall be provided with vents of such sizes as to prevent any gas pressure accumulating inside the cap or the cover, except in the case of toxic gases where the cap shall be gas-tight and shall be able to withstand the full pressure.

8.3 Foot Rings

Foot rings, if provided, shall be sufficiently strong and made of material compatible with that of the cylinder The shape shall be preferably cylindrical and shall give the cylinder sufficient stability Foot rings shall not form water traps and when shrunk on, the gap shall be sealed to prevent ingress of water In no case foot rings shall be welded to the cylinder body. They shall conform to the requirements of the specification to which the cylinder is manufactured

8.4 Safety device, if fitted to the valve, shall be properly maintained

9 PAINTING

9.1 The cylinders shall be painted with the colour specified in *Gas Cylinder Rules* The colour of the paint on the cylinder shall always be maintained by periodically repainting them (*see* IS 4379)

9.2 In case of ship cylinders and export cylinders colour of the paint may not be changed and if repainting is considered necessary the colour may remain the same as that adopted in the country of use.

10 FILLING FOR CYLINDER

Cylinders meeting the requirements as given in **6.1** and **6.2** may be accepted for filling except for acetylene cylinders (*see* **10.10**). Care shall, however, be taken not to fill a cylinder with wrong gas inadvertently

10.1 Filling plants for flammable gases shall be adequately earthed to discharge to earth any static electricity that might set in during filling

10.2 Plant equipment shall be provided with arrangement to prevent air entering into the system while changing over from one filling bank to another; caused by removing full and connecting empty cylinder

10.3 All cylinders received with or without residual gas shall be either purged or evacuated at the filling plant before filling

10.4 For high pressure liquefiable gases cylinders shall be filled according to filling ratio specified in IS 8866.

10.5 Residual gas in empty cylinders meant for gases other than argon, helium, neon and nitrogen shall be blown out prior to filling

NOTES

1 Flushing shall be carried out for all medical oxygen cylinders whether empty or containing residual gas prior to filling

2 All hydrogen cylinders received without residual gas shall be either purged or evacuated at the filling plant before filling hydrogen

10.6 No cylinder shall be filled in excess of its specified working pressure at 15°C (*see also* IS 8775)

10.7 Cylinders shall be filled in an approved filling station only

10.8 Flame shall not be used for checking leak in cylinders

10.9 For checking leak of valve socket, particularly for oxygen cylinders, plain water or a dry leak tester shall be used Soap water may be used for checking leaks in other parts

NOTES

1 To avoid filling cylinders with wrong gas inadvertently, receipt, examination and filling of various gas cylinders shall be isolated from each other

2 Filling staff shall also identify the cylinders from their colour and gas symbols punched on the cylinders before proceeding to fill them The identification of gases by colour coding shall be considered as secondary

3 Cylinders designed for dry gas filling shall be filled with dry gases only

10.10 Filling for Acetylene Cylinder

10.10.1 Cylinders shall be examined for tare weight In case of weight found to be less than the stamped tare weight, acetone to be charged in cylinder to make up the weight loss

10.10.2 Compression of acetylene shall be carried out only on such premises as shall be approved by the statutory authority

10.10.3 No person shall charge acetylene in a cylinder unless he is in possession of full particulars and previous history of such cylinders and has otherwise assured himself that the cylinder complies with the statutory authority.

10.10.4 Any shortfall in quantity of acetone that exceeds the permissible limit recommended by the

manufacturer shall be made good before a cylinder is sent for recharge.

10.10.5 The maximum pressure to which a cylinder can be charged shall be such that it does not exceed 16 kgf/cm^2 at 15°C when acetone is the solvent and that the quantity of gas charged shall be within the permissible limit recommended by the manufacturer

10.10.6 Leakage in connections and safety plug shall be periodically checked. If there is leakage in the safety plug it shall not be attempted to be stopped by caulking The cylinder shall be removed and gas blown down and the safety plug shall be attended to or renewed.

11 MARKING AND LABELLING

11.1 Marking

11.1.1 *On Cylinders*

Each cylinder shall be permanently stamped at the valve pad of the cylinder and on the cylindrical part of the body with the following markings The manufacturer's symbol and number may be marked on the base of the cylinder:

a) Serial number and identification of manufacturer and year of manufacture,

b) Number of this standard;

c) Test pressure and date of the hydraulic test with code mark of the station where the test was carried out (such as 4/04 for April 2004),

d) Tare weight, in kg (except in case of dissolved gas cylinders or liquefiable petroleum gas cylinders) [*see* Notes under **6.2.6**];

e) Water capacity, in litres,

f) Inspector's official mark,

g) Symbol for heat treatment;

h) Filling pressure at 15°C, in kgf/cm^2, in case of permanent gases and filling ratio for high pressure liquefiable gasses; and

j) Name of chemical symbol of the gas for which cylinder is to be used.

NOTE — The stamps used for marking shall have small radii at changes of section to avoid formation of sharp edges in the stamped marking

11.1.2 *On Cylinder Valves*

a) Number of the specification to which valve conforms,

b) Maximum working pressure,

c) Quarter and year of manufacture,

d) Manufacturer's identification symbol, and

e) Name of the gas

11.2 Labelling

Each filled cylinder shall carry an adhesive label detailing the name of the filling station, its location, name of the gas and the warning instruction as stipulated in the *Gas Cylinder Rules*, 1981

11.2.1 Adhesive label shall be so pasted on the cylinder that it does not cover the marking on the cylinder shoulder

12 STORAGE (AT CONSUMER'S END)

12.1 Special precautions are necessary where cylinders are stored Prior approval from the statutory authority shall be taken, whenever necessary

12.2 Cylinders shall preferably be stored under cover where they can be protected against corrosion and frost Where possible, store shall be in a detached building of non-combustible construction If the cylinders are stored in part of the building used for some other purpose, the store shall be

a) in ground floor of the building in a room against an outside wall with a door or doors leading to the open,

b) separated from the rest of the building by walls and floors having a fire resistance of at least 2 h, and

c) entirely of non-combustible construction.

12.3 The store shall not be used for any purpose other than storage of cylinders of particular gas.

12.4 The store shall be provided with good natural ventilation and shall have ventilation openings at both high and low levels

12.5 The location of the doors and the layout of the store shall be such that the cylinders may be removed easily in the event of fire

12.6 Stores shall be indicated by suitable notices and exits shall be kept free from obstruction

12.7 Cylinders with flat bases may be stored upright in single tiers and a gangway shall be after every fourth row to permit access and handling of cylinders.

12.8 Cylinders with round base shall be stacked horizontally. If these are to be stacked vertically, suitable stand shall be provided and not propped against walls, benches or other cylinders. Acetylene cylinders should be always stored in upright condition

12.9 If cylinders are stacked horizontally, larger cylinders shall be placed at the bottom and positive steps shall be provided to prevent the cylinders from rolling. A gangway shall be provided between neighbouring stack of cylinders.

12.10 Thin walled cylinders, such as of high alloy steel, shall preferably be stored vertically. Where this is not possible, these cylinders may be stacked horizontally by suitably reducing the number of tiers so that cylinders at the bottom can easily withstand weight over them.

12.11 Empty cylinders shall be kept separated from filled ones. This arrangement makes it unnecessary to open valves to see if the cylinders are full or empty.

12.11.1 Distinctive notice shall be displayed to prevent confusion. A common practice is to chalk mark 'MT' on empty cylinders.

12.12 Protective caps, where provided, shall be screwed down over valves when cylinders are not in use.

12.13 All cylinders not in use shall be kept in an appropriate store

12.14 Valves of empty cylinders shall be kept closed at all times

12.15 Cylinders shall not be exposed to continuous dampness and shall not be stored near salt or other corrosive chemical or fumes Rusting damages the cylinders and may cause the valve protection caps to stick.

12.16 During winter, cylinders shall be protected against accumulation of ice or snow

12.17 Cylinders shall be protected from tampering by unauthorized individuals

12.18 Specific Precaution for Hydrogen and Acetylene Cylinders

12.18.1 Inside any building, hydrogen and dissolved acetylene cylinders shall not be stored in close proximity to cylinders containing oxygen, unless well separated There shall be a fire-resistant partition between the hydrogen cylinders and oxygen cylinders Hydrogen cylinders may be stored with cylinders containing other combustible gases, but in such cases the various gases shall be segregated.

12.18.2 Hydrogen and dissolved acetylene cylinders used with oxygen for welding and cutting and stored inside a building shall be limited to a total capacity of 60 m^3 exclusive of cylinders in use or attached for use Quantities exceeding this total shall be stored in a special building or separate room or shall be stored outside Flashback arrestors to be fitted on the cylinders for welding and cutting

12.18.3 Hydrogen and dissolved acetylene cylinders shall not be allowed to reach a temperature exceeding 55°C and 52°C, respectively because of the rise in pressure in the cylinder with change of temperature. Cylinders shall, therefore, not be stored near furnace, radiators or any other source of heat

12.18.4 Hydrogen and dissolved acetylene cylinders shall be protected from abnormal mechanical shock which is liable to damage the cylinder and valve. Cylinders shall not be stored near elevators or gangways or in locations where heavy moving objects may strike or fall on them

12.18.5 If electric lighting is provided in the store, it shall be of flame proof construction approved by the statutory authority

12.18.6 Hydrogen and dissolved acetylene cylinder valve shall not be sniffed to clear the valve outlet of dust, etc, since high pressure hydrogen is very likely to catch fire on sudden expansion

12.18.7 While approaching a hydrogen leak, hold some readily combustible material such as newspaper as hydrogen burns with invisible flame.

12.18.8 Conspicuous sign shall be posted in the storage area forbidding smoking, open light or other flames

12.18.9 Acetylene cylinder may be stored in open but in such cases they shall be protected against extreme weather and from ground beneath to prevent rusting. The spindle key of an acetylene cylinder should always be kept on the valve spindle when cylinder is in use

12.19 Specific Precaution for Oxygen Cylinders

12.19.1 Additional precautions are necessary for storing oxygen cylinders Some means of venting an explosion shall be provided. In a single-storey building the best method is to make the roof of light construction as this will help to vent an explosion upwards If the store is a part of a building used for other purposes, special arrangement will be necessary to vent explosions safely These may include more substantial internal walls and ceilings if there are storeys above the store, to protect occupants from blast and panels of light construction in external walls to vent explosions outwards, provided there is no risk of injury to people outside

12.19.2 Conspicuous signs shall be posted in the storage area forbidding smoking, open lights or other open flames

12.19.3 Oxygen cylinders shall be kept separated from cylinders containing flammable gases and wherever possible in a separate room

12.19.4 Oxygen cylinders shall not be stored where oil, grease or other readily combustible substance may come in contact with them Oil and oxygen may combine with explosive violence.

12.19.5 Cylinders shall not be stored in the operating rooms

12.20 Specific Precaution for Nitrous Oxide Cylinders

Nitrous oxide cylinder shall be stored in an assigned little frequented location, making sure not to store them in the same room with cylinder containing reserve stock of flammable gases Medical cylinder of nitrous oxide should not be stored in the hospital operation theater

13 HANDLING (AT CUSTOMER'S END)

13.1 The gas shall be called by its name so that no confusion exists

13.2 Adequate care shall be taken in handling cylinders so that these are not dropped or struck against each other violently Cylinders shall be adequately supported to prevent falling down during use In horizontal position the cylinders shall be secured so that it cannot roll Trolleys and cradles shall be used during handling

13.3 Repairing, painting or altering colour of cylinders or valves shall not be done If the cylinder valve is leaking around the spindle, the gland nut should be tightened

13.4 Cylinders shall not be placed where they might become part of an electric circuit. Where cylinders are used near or in conjunction with electric welding, precaution should be taken against accidental grounding of compressed gas cylinders and allowing them to be burned by electric welding arc.

13.5 Stamped marking on cylinders should not be tampered

13.6 Marking which are used for identification of contents of cylinders should not be defaced or removed This also applies to labels, tags and stenciled marks

13.7 Cylinders shall not be used as rollers, supports or any purpose other than for which they are intended

13.8 In moving cylinders, it is important to remember that they should not be subjected to abnormal mechanical shocks which might damage the cylinders and the valves Care should be taken to ensure that cylinders are not dropped or permitted to strike against each other violently

13.9 Valve protection cap shall not be used for lifting cylinders from one position to another Before raising a cylinder provided with valve protection cap from a horizontal to a vertical position, it should be seen that the cap is properly placed hand-tight, then the cylinder raised by grasping the cap

13.10 Horizontal movement of cylinders is easily accomplished by the use of a hand truck. When a hand truck is used, some method, such as chaining, should be used to hold cylinders securely in an upright position Cylinders should not be transported lying horizontally on truck with valve overhanging in a position to collide with stationary objects. Cylinders should not be dragged from place to place.

13.11 Valves should always be closed before cylinders are moved

13.12 It is sometimes necessary to transport cylinders by crane or derrick Lifting magnet sling or rope or chain, or any other device in which the cylinders themselves form a part of the carrier shall not be used for hoisting cylinders Instead, when the crane is used, a platform, cage or cradle shall be provided which will protect the cylinders from damage by slamming against obstructions and will keep them from falling out. The preferred construction is to build one which will take one or more cylinder

13.13 Precaution

13.13.1 Cylinder shall not be

a) lifted with an electromagnet,
b) kept near elevator, gangway or in a location where moving object can fall on it,
c) left near a source of heat like furnace, flame or naked light or hot slag or radiator;
d) kept close to welding or cutting work so that spark may fall on it,
e) used as roller, support or for any purpose other than storing gas;
f) kept in contact with an electric wire or fitting so that it may become path of an electric circuit,
g) kept near acid or corrosive substance,
h) kept so as to obstruct the approach to a fire extinguisher,
j) lifted by its cap,
k) dragged or slided on floor (a suitable hand cart should be used); and
m) rolled over oily or greasy floor

13.13.2 Oxygen and nitrous oxide cylinder should not come in contact with oil, grease or any other combustible substance.

13.13.3 Care to be taken to avoid exhausting a nitrous oxide cylinder completely when using it with either anesthesia, in order to prevent the possibility having either drawn back into the cylinder Nitrous oxide cylinders should always be protected against feedback of other gases or foreign material by suitable traps or check valves in line to which the cylinders are connected

13.13.4 Nitrous oxide should not be transferred from one cylinder to another cylinder except by an

approved decanting station, instead the cylinder should always be returned to charging plants for refilling. Refilling to be done in the plants under recognized practices

13.13.5 Owner of cylinders should be notified, giving details and cylinder numbers, in case any condition has occurred which might permit any foreign substance to enter the cylinder or valve to enable them taking precautions before refilling

14 BRINGING CYLINDER IN SERVICE

14.1 The gas should be called by its name to avoid any possible confusion The contents of a cylinder shall not be used without suitable pressure regulating device or flow regulating device. Flow regulation by means of cylinder valve may lead to danger It should be either in full open or full closed position

14.2 Except hydrogen cylinder, before connecting the cylinder to a regulator or manifold the valve should be momentarily opened and closed to remove any loose dirt or dust from inside the valve socket The operator should stand clear of the outlet while doing this

14.3 *Valves of cylinders shall be closed before* breaking the outlet connections from them

14.4 Cylinders with leaky valves shall not be used

14.5 Connections that do not fit shall not be forced It is important to make sure that the threads on regulator to cylinder valve connections are properly mated No jointing compound shall be used

14.6 Test for leakage at connections shall be made by using soap water Testing leakage with a naked flame shall not be done

14.7 Opening the valve of a full cylinder shall not be done rapidly but slowly

14.8 A worn out spindle key shall not be used for opening or closing cylinder valve as it may damage the square head of the spindle

14.9 Extra leverage shall not be used on the cylinder spindle key for operation

14.10 A worn out spanner shall not be used for loosening or tightening the gland of the cylinder valve.

14.11 Cylinder valve shall be kept closed at all times except when gas is actually being used

14.12 Torch should not be applied to the side of a cylinder to raise the pressure or for any other reason

14.13 No hammering shall be done on the gland nut or on the gas outlet in attempting to open or close the same

14.14 For Hydrogen Cylinder

14.14.1 The hydrogen cylinder to be used in an upright position should be secured so that it can not be knocked down.

14.14.2 Valve protection cap should be removed just before connecting the cylinder to a manifold or regulator.

14.14.3 Contrary to general practice with other gas cylinders, hydrogen cylinder, valves should not be cracked before connecting to regulator or manifold since self-ignition of the issuing hydrogen may sometimes occur

14.14.4 Hydrogen pressure reducing regulator should always be connected to the hydrogen cylinder Hydrogen from a cylinder without reducing the pressure, through a suitable regulator at the cylinder or at the outlet of the header valve or a cylinder manifold, should not be used

14.14.5 In case of hydrogen cylinder valve required opening, it shall be opened slowly so that hydrogen does not enter the regulator suddenly. The valve opening should be pointed away from the operator. Wrenches or tools should not be used except those provided or approved by the gas manufacturer The use of a wrench or valve equipped with hand wheels should be avoided Hammering of the valve wheel in attempting to open or close the valve should not be done If valves cannot be opened by hand the supplier should be notified

14.15 It should be made certain that the threads on regulator or leads for connecting the cylinders to manifold headers correspond to those cylinder valve outlets Connections which do not fit should not be forced Interchange of regulators, hose or other appliances with similar equipment intended for use with other gases should not be done

14.16 After attaching the regulator and before the cylinder valve is opened, it should be seen that the adjusting screw of the regulator is released

14.17 It should be made sure that all connections are gas-tight and remain so and that the connected hose is in good condition and does not have any leaks

14.18 The cylinder valve should be fully opened when cylinder is in use

14.19 Torch should not be applied to the side of a cylinder to raise the pressure or for any other reason.

14.20 The cylinder valve should be closed when the work is finished It should be made sure that the cylinder valve is closed and all gas released from regulator before removing the regulator from a cylinder.

14.21 Before using the cylinder it shall be made sure that it contains the same gas which is required to be used.

15 HANDLING OF LEAKING CYLINDERS

15.1 If gas cylinder leaks around the valve spindle when the cylinder valve is open even after tightening the gland nut, the valve should be closed and a tag attached to the cylinder stating that the valve is unserviceable The supplier should be notified and his instructions should be followed as to the return of the cylinder

15.2 If hydrogen leaks from the valve even when the valve is closed, the cylinder should be carefully removed to an open space out of doors and well away from any possible source of ignition The cylinder should be tagged as in the case of unserviceable valve (extreme caution is recommended here because the leaking hydrogen may sometimes ignite in the absence of any normally apparent source of ignition, and if so, will burn with almost an invisible flame) Warnings should be posted against approaching the cylinder with lighted cigarettes or other source of ignition The supplier should be notified immediately and his instructions asked for further handling of the cylinder

15.3 When cylinders have been emptied

a) Cylinder valve should be closed and the valve protecting cap replaced, and

b) Cylinders should be promptly returned to the supplier in accordance with his instructions

15.4 Handling of Leaking Dissolved Acetylene Cylinders

15.4.1 As acetylene and air in certain proportion are explosive, care should be taken to prevent acetylene leakage. Connection should be kept tight and hose maintained in good condition Points of suspected leakage shall be tested by covering them in soapy water A leak can be indicated by bubbles of escaping acetylene passing through the soap film. Leaks shall not be tested with flame

15.4.2 If acetylene leaks around the valve spindle when the valve is open, the valve should be closed whereas the gland nut tightened. If this does not stop the leak, the valve should be closed and a tag attached to the cylinder stating that the valve is unserviceable The gas supplier should be notified and his instructions for return of cylinder followed.

15.4.3 If acetylene leaks from the valve even when the valve is closed or if any rough handling has caused any fusible safety plug to leak profusely, the cylinder should be moved to an open space well away from any possible source of ignition A tag should be attached to the cylinder stating that the valve or plug is unserviceable A sign should be placed at cylinder in case cylinders having leaky fusible plug, warning persons against approaching the cylinder with cigarette or other open lights. When the cylinder is empty, the valve should be closed The supplier should be notified immediately the serial number of the cylinder and the particulars of its defects as far is known, and his instruction awaited

16 TRANSPORTATION

16.1 Additional care shall be taken in handling cylinders so that these are not dropped or struck against each other violently. Cylinders shall be adequately supported to prevent falling during use In horizontal position the cylinders shall be secured so that it cannot roll Trolleys and cradles shall be used while moving them

16.2 Cylinders shall not project in the horizontal plane beyond the sides or ends of the vehicles in which they are transported.

16.3 Cylinders on vehicles shall be blocked or braced and secured to prevent movement or falling down

16.4 There shall not be any sharp projections on the inside of the vehicle which can damage the cylinder wall

16.5 Lighter cylinders shall be kept on the top of the heavier ones during transit

16.6 A leaky cylinder shall not be transported knowingly

16.7 When filled cylinders are transported by rail it shall be done in accordance with the *Railway Red Tariff Rules*

16.8 Valve protection cap shall not be used for lifting cylinders from one position to another Before raising a cylinder provided with valve protection cap, from a horizontal to a vertical position, it should be checked that the cap is placed hand-tight, then the cylinders can be raised by grasping the cap

17 GENERAL PRECAUTIONS

17.1 Gas cylinders should be handled by properly instructed and trained persons

17.2 Attempt shall not be made to remove the valve from the cylinder body except in a testing station

17.3 Cylinders with defects shall be immediately labelled appropriately and returned to the supplier

17.4 Marking and identification colour of a cylinder shall not be defaced

17.5 If any accident, fire or explosion occurs involving the cylinder which is attended with loss of life or serious injury to person or property, this shall be immediately reported to the nearest Magistrate or to the Officer-in-Charge of the nearest Police Station and by express telegram to the Chief Controller of Explosives as required under *Gas Cylinder Rules*, 1981 Cylinders serial No./Nos , gas etc, shall be intimated

17.6 In welding shops and industrial plants using both oxyacetylene and electric welding apparatus, care shall be taken to avoid handling of this equipment in any manner which may permit the gas cylinders to come in contact with the electric welding apparatus or electrical circuits

17.7 When there is doubt in proper handling of a gas cylinder, the manufacturer or supplier of the cylinder should be consulted

18 RECORDS

18.1 Filling station shall maintain the following record in respect of each cylinder examined and tested for filling:

a) Name of the manufacturer and owner,
b) Cylinder number,
c) Specification to which the cylinder conforms,
d) Date of original hydrostatic stretch test,
e) Test reports and certificates furnished by the manufacturer, if available,
f) Test pressure;
g) Maximum working pressure,
h) Water capacity, in litres,
j) Date of the last hydrostatic stretch test and name of the testing station,
k) Tare of the cylinder;
m) Variation, if any, in the tare marked on the cylinder and actual tare at the time of hydrostatic stretch test,
n) Name of gas,
p) Type of valve fitted, and
q) Remarks.

18.1.1 Permission obtained from the statutory authority permitting the use of cylinder shall be preserved till the cylinder is condemned

ANNEX A

(*Clauses* 5.1 *and* 6.1.1)

LIST OF APPROVED SPECIFICATIONS

A-1 The list of specifications approved by the statutory authority for use in India is given below

IS 7285 1988	Seamless manganese steel cylinders for permanent, dissolved and liquefiable gases (*second revision*)
JIS B 8241 1989	High pressure gas cylinders, Japanese Industrial Standards Committee
PN-76/M-69222	Steel cylinders without seam, Polski Komitet Normalizacji I Miar
BS 5045-1 1976	Transportable gas containers — Part 1 : Seamless steel containers, British Standards Institution
BS 5045-7 2000	Transportable gas containers — Part 7 Specification for seamless steel gas containers of water capacity 0 5 L up to 15 L for special portable application, British Standards Institution
BS EN 1964-1 2000	Transportable gas cylinders Specification for designed and construction of refillable transportable seamless steel gas cylinders of water capacity 0 5 ltr and up to and including 150 lts Part 1 Cylinder made of seamless steel with an R_m value less than 1 100 MPa
GOST 949 1973	Gas cylinders up to 200 kgf/cm^2 nominal pressure (Gosudarstvennyj Komitet Standartov Soveta Ministry S S S R) United Kingdom Home Office Specification 'S' and 'T' for seamless alloy steel cylinders for conveyance of compressed gases
DOT 3A 1800	United States of America Department of Transport, Interstate commerce (49 CFR) commission regulations for the transportation of explosives and other dangerous articles
DOT 3AA 1800	United States of America Department of Transport, Interstate commerce (49 CFR) commission regulations for the transportation of explosives and other dangerous articles

NOTE — This list is not comprehensive as new specifications are added from time to time

Up-to-date information on the subject can be had from the Chief Controller of Explosives, Nagpur

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinders Sectional Committee, ME 16

Organization	*Representative(s)*
Department of Explosives, Nagpur	SHRI R H BHALEKAR (*Chairman*) SHRI C R SURENDRANATHAN (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	*SHRI A R SINGH* SHRI S DEB (*Alternate*)
Balmer Lawrie & Co Ltd, Mathura	SHRI K GOPINATHAN SHRI DEBASHIS DASS (*Alternate*)
Bharat Petroleum Corpn Ltd, Mumbai	SHRI GEORGE PAUL SHRI S K DEY (*Alternate* I) SHRI SURESH NAIR (*Alternate* II)
Bharat Pumps & Compressors Ltd, Allahabad	SHRI UTTAM KUMAR SHRI S K TEWARI (*Alternate*)
BOC India Ltd, Kolkata	SHRI P K BHATTACHARYA SHRI N R PAL (*Alternate*)
Everest Kanto Cylinder Ltd, Aurangabad	SHRI AJIT K PARIKH SHRI P M SAMVATSAR (*Alternate* I) SHRI A G KHAMKAR (*Alternate* II)
Hindustan Petroleum Corpn Ltd, Mumbai	SHRI K KRISHNAN SHRI D N KRISHNAMURTHY (*Alternate*)
Hindustan Wires Ltd, Faridabad	SHRI R TANDON SHRI N K SAWHNEY (*Alternate*)
Indian Gas Cylinders, Faridabad	SHRI E M PATEL SHRI D C JAIN (*Alternate*)
Indian Oil Corpn Ltd, Mumbai	SHRI B L BANSAL SHRI A N KHAPRE (*Alternate*)
International Industrial Gases Ltd, Kolkata	SHRI D K GARG SHRI N K GARG (*Alternate*)
J R Fabricators Ltd, Mumbai	SHRI ASHWIN H MEHTA SHRI S SESHKUMAR (*Alternate*)
Kabsons Gas Equipments Ltd, Hyderabad	SHRI SATISH KABRA SHRI S SONI (*Alternate*)
Kosan Industries Ltd, Mumbai	SHRI A T AZADEDO SHRI D R BHAGALIA (*Alternate*)
LPG Equipment Research Centre, Bangalore	SHRI I M BHOLA SHRI S M VENUGOPAL (*Alternate*)
Maruti Koatsu Cylinders Ltd, Mumbai	SHRI A S SARAN SHRI N J KALE (*Alternate*)
Met Lab Services Pvt Ltd, Mumbai	SHRI S C PARIKH SHRI SUDHIR KAUL (*Alternate*)
Ministry of Defence (R&D), Pune	SHRI N K CHOPRA SHRI A BASU (*Alternate*)
Ministry of Defence (DGQA), Pune	SHRI K PARTHIBAN SHRI D D BANGAR (*Alternate*)
Nagpur Fabriforge Pvt Ltd, Nagpur	SHRI G L NEEMA SHRI A M TIRE (*Alternate*)

Organization	*Representative(s)*
M N Dastur & Co Ltd, Kolkata	SHRI A K CHAKRABARTY SHRI P K BANDYOPADHYAY (*Alternate*)
National Safety Council, Mumbai	SHRI H N GUPTA
Shri Shakti LPG Ltd, Hyderabad	SHRI J P RAMAPPA SHRI K V CHALAPATHY RAO (*Alternate*)
In personal capacity (*303 Shantikunj Athwalines Surat*)	SHRI I. D THAKKAR
BIS Directorate General	SHRI M I CHOPRA, Director & Head (MED) [Representing Director General (*Ex-officio*)]

Member Secretary
SHRI S B ROY
Director (MED), BIS

Dissolved Acetylene Cylinders, Generators, Acetylene Pipe Lines and High Pressure Gas Cylinders Subcommittee, ME 16 3

Bharat Pumps and Compressors Ltd, Allahabad	SHRI UTTAM KUMAR (*Convener*) SHRI S K TIWARI
All India Industrial Gases Manufacturers Association, New Delhi	SHRI A R SINGH SHRI S DEB (*Alternate*)
BOC India Ltd, Kolkata	SHRI P K BHATTACHARYA SHRI N R PAL (*Alternate*)
Department of Explosives, Nagpur	SHRI R H BHALEKAR SHRI C R SURENDRANATHAN (*Alternate*)
International Industrial Gases Ltd, Kolkata	SHRI D K GARG SHRI N K GARG (*Alternate*)
Industrial Oxygen Co Pvt Ltd, Mumbai	SHRI R R SIGANPORIA
Jai Maruti Gas Cylinders Pvt Ltd, Gwalior	SHRI ASHOK K NIGAM SHRI P K NIGAM (*Alternate*)
M N Dastur & Co Ltd, Kolkata	SHRI A K CHAKRABARTY SHRI P K BANDYOPADHYAY (*Alternate*)
Maruti Koatsu Cylinders Ltd, Mumbai	SHRI A S SARAN SHRI N J KALE (*Alternate*)
Met Lab Services Pvt Ltd, Mumbai	SHRI S C PARIKH SHRI SUDHIR KALE (*Alternate*)
Ministry of Defence (DGQA), Pune	SHRI K PARTHIBAN SHRI D D BANGAR (*Alternate*)

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments Standards are also reviewed periodically, a standard along with amendments is reaffirmed when such review indicates that no changes are needed, if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards Monthly Additions'

This Indian Standard has been developed from Doc : No MED 16 (0691)

Amendments Issued Since Publication

Amend No	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones 2323 0131, 2323 33 75, 2323 9402

Telegrams Manaksanstha
(Common to all offices)

Regional Offices		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	2323 7617, 2323 3841
Eastern	: 1/14 C I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700 054	2337 8499, 2337 8561, 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160 022	60 3843, 60 9285
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600 113	2254 1216, 2254 1442, 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093	2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD GHAZIABAD. GUWAHATI. HYDERABAD JAIPUR. KANPUR LUCKNOW. NAGPUR. NALAGARH PATNA PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM

Printed at Prabhat Offset Press, New Delhi-2